DIGITAL MAPPING PROGRAMME

Implementing a new geological data capture and compilation system

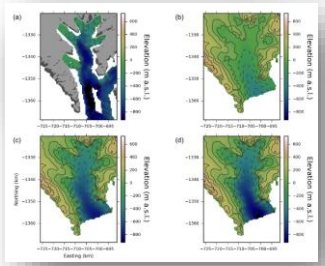
Autumn 2024

Dr Chris Williams *Head of Digital Mapping*

British Geological Survey

Some background…

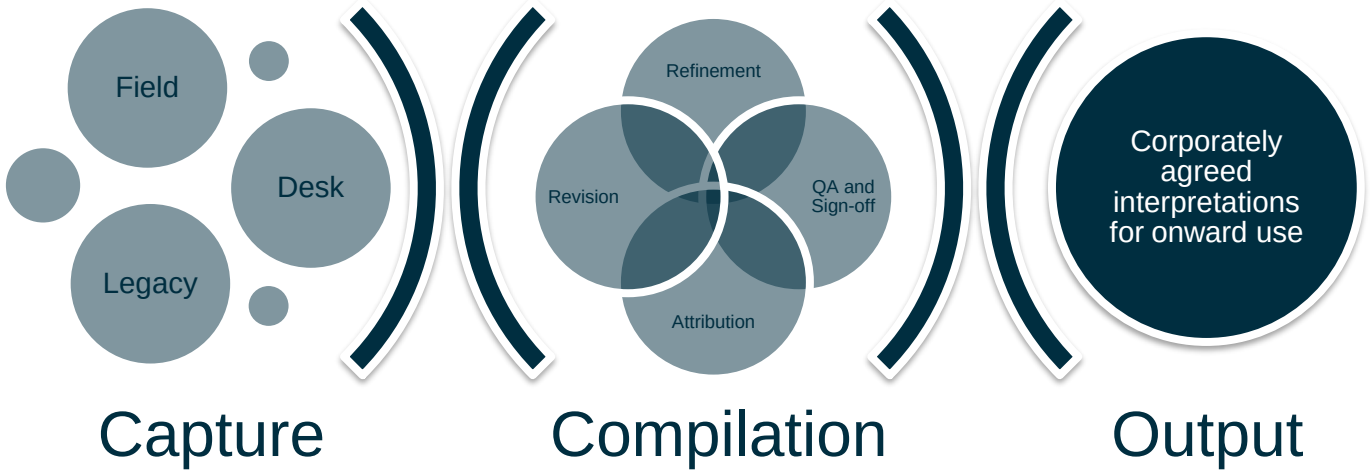
- Geographer with research background in wider geoscience
  - Field / Analysis / Modelling
  - Glacier-environment interactions
  - Environmental systems
  - Geospatial data manipulation and analytics
- BGS since 2017
  - Geospatial analytics
  - Geo-data related process and systems design
  - Oversee the Digital Mapping Programme



OVERALL PROGRAMME AIM

To define, develop and maintain the tools and pipelines that underpin BGS's geological mapping capability – from capture, to compilation and map development

Programme vision



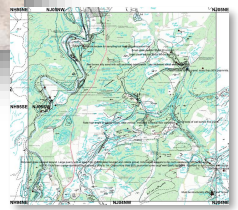
Centralised storage and continuous auditing for transparency and reproducibility

Where we're coming from

Data capture

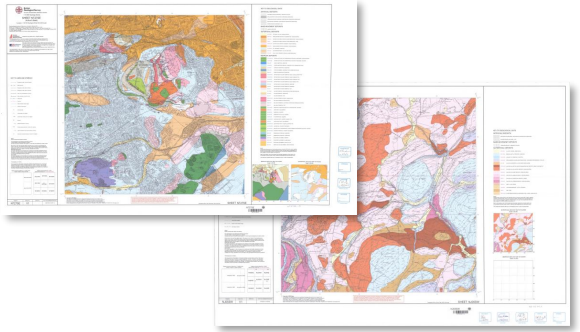
Compilation

Approved mapping



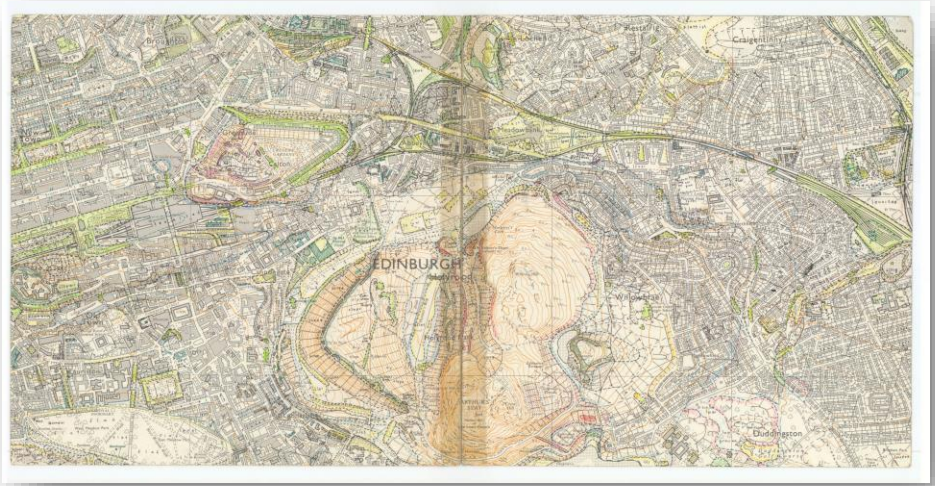
Σigma • MOBILE
System for integrated Geoscience Mapping

ArcGIS ArcMap 10.8.2
esri

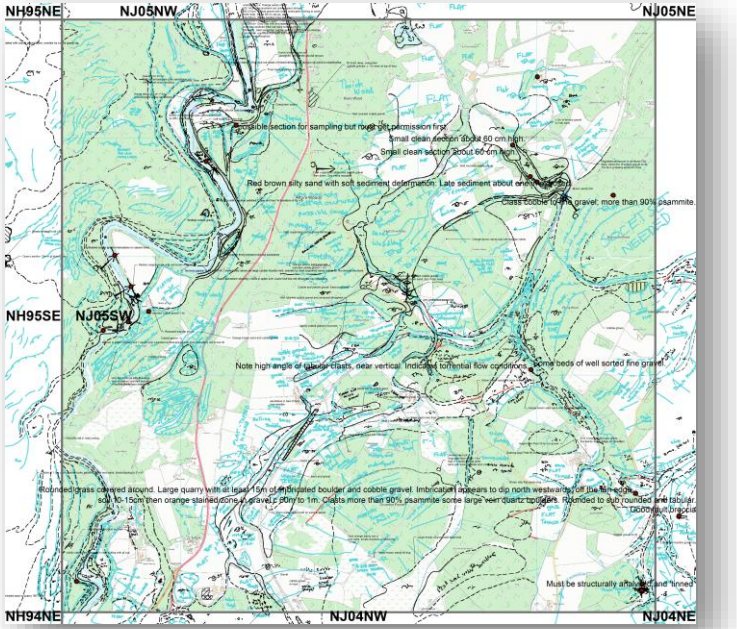


Various storage formats / mixed analogue-digital auditing

Data capture

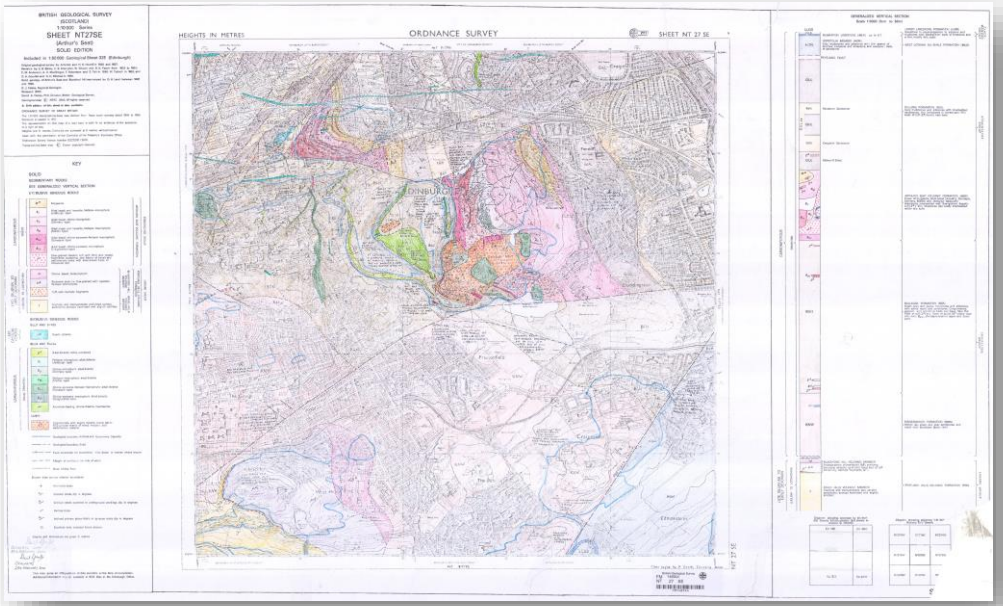


Traditional Field Slip



Digital Field Data

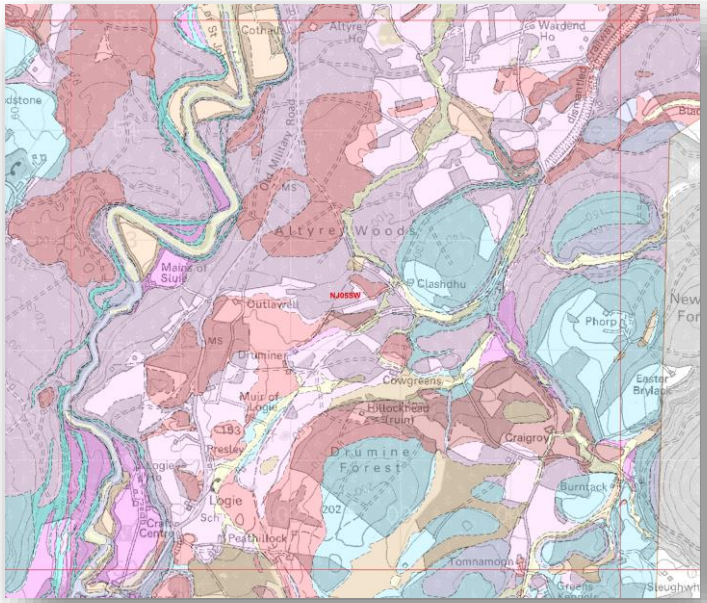
Compilation



Fair copy to Standard following approval

Hand coloured

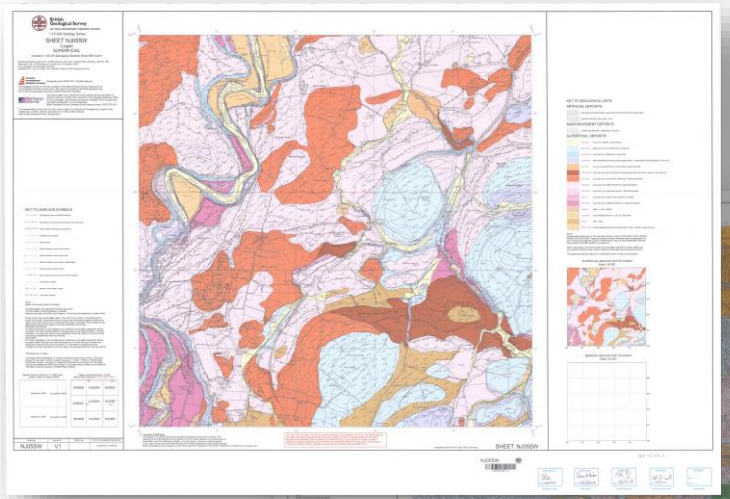
Geologists and cartographers



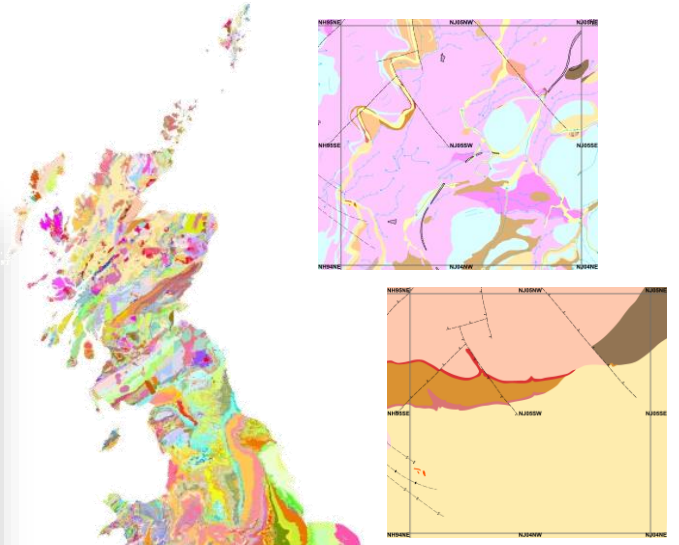
Digital process

Geologists and cartographers

Approved mapping



Printed maps(standards)



BGS Geology 10k & 50k

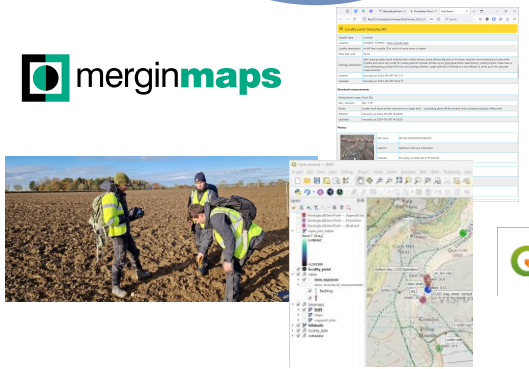
https://www.bgs.ac.uk/map-viewers/geoindex-onshore/
https://www.bgs.ac.uk/information-hub/bgs-maps-portal/

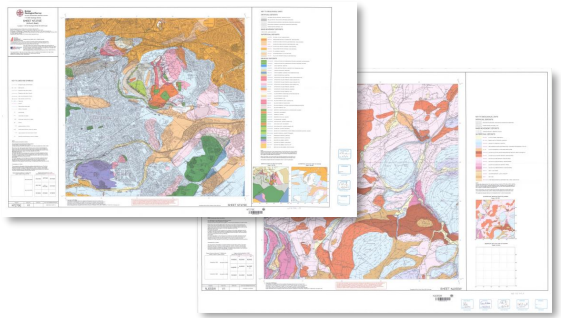
Where we're going

Data capture

Compilation

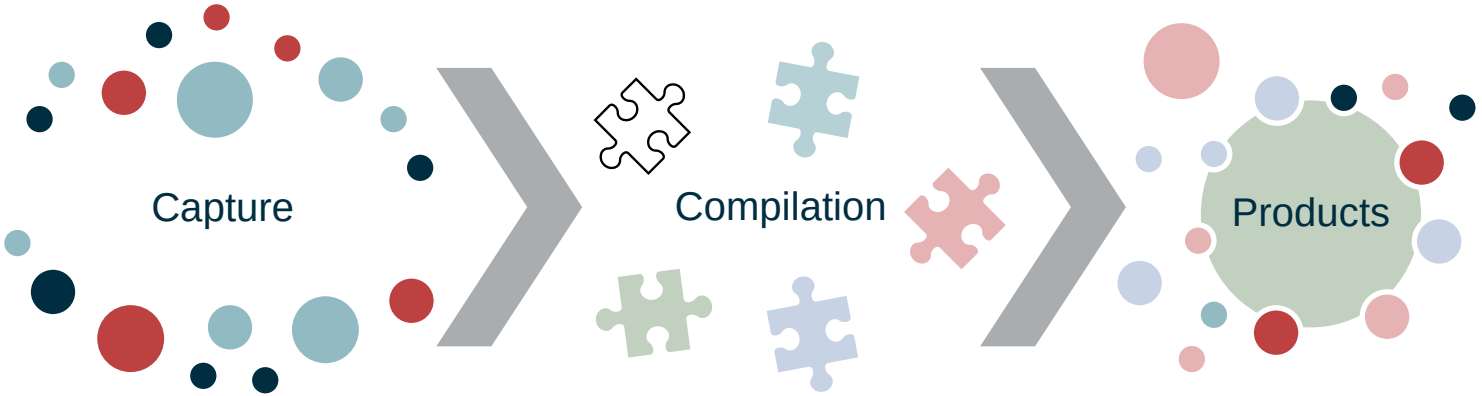
Approved mapping





Standard storage formats / full digital auditing

Transparent workflows



Redesigning the infrastructure to ensure separation of data and process

Completing the digital transformation

Digital Mapping / Service Blueprint

British Geological Survey

PROCESS

DATA DISSEMINATION

Data accessed from ORACLE by various means according to various delivery mechanisms to support data dissemination

DATA STORAGE

PRODUCT

Store of current (and subsequently deprecated) products, easily findable by suitable metadata tags

APIs
Maps
Web Apps
Sections
Reports
Datasets
3D Maps
Samples

PROCESS

PRODUCT DEVELOPMENT

Workflows that create various products based on the geological geometries stored in the COMPILED store

PRODUCT SIGN-OFF

DATA STORAGE

COMPILED

Data stored in here will related to geological geometries and prior defined attribute fields + additional metadata that clarifies data is the officially agreed interpretation as of a specific date

DATA STORAGE

PRODUCT-STAGING

ORACLE container where work in progress, as yet unsigned off is stored and accessed from

PROCESS

DATA CAPTURE

Process of capturing data from different sources and in different environments from field to desktop

GEOLOGICAL SIGN-OFF

DATA STORAGE

COMPILED STAGING

COMPILED STAGING is the container within which all data being manipulated in the compilation stage is stored

Field
Analogue
Digital

DATA STORAGE

RAW DATA

Contains all captured information, including spatial features (points, lines), notes, photographs etc.

PROCESS

GEOLOGICAL COMPILATION

Process of compiling data collected in the field, cleaning up linework, LEX-RCS attribution etc.

Where changes are agreed that update previously signed off records, geometries can be changed to update records stored in the COMPILED store, but must pass back through the sign-off process before doing so, at which point metadata will also be updated.

Illustrations by macrovector on Freepik

Data capture development

GIS and QA

Focus groups

Regional Geologists

Geological QA

Database and infrastructure

Software tool development

Product development

Internal stakeholders

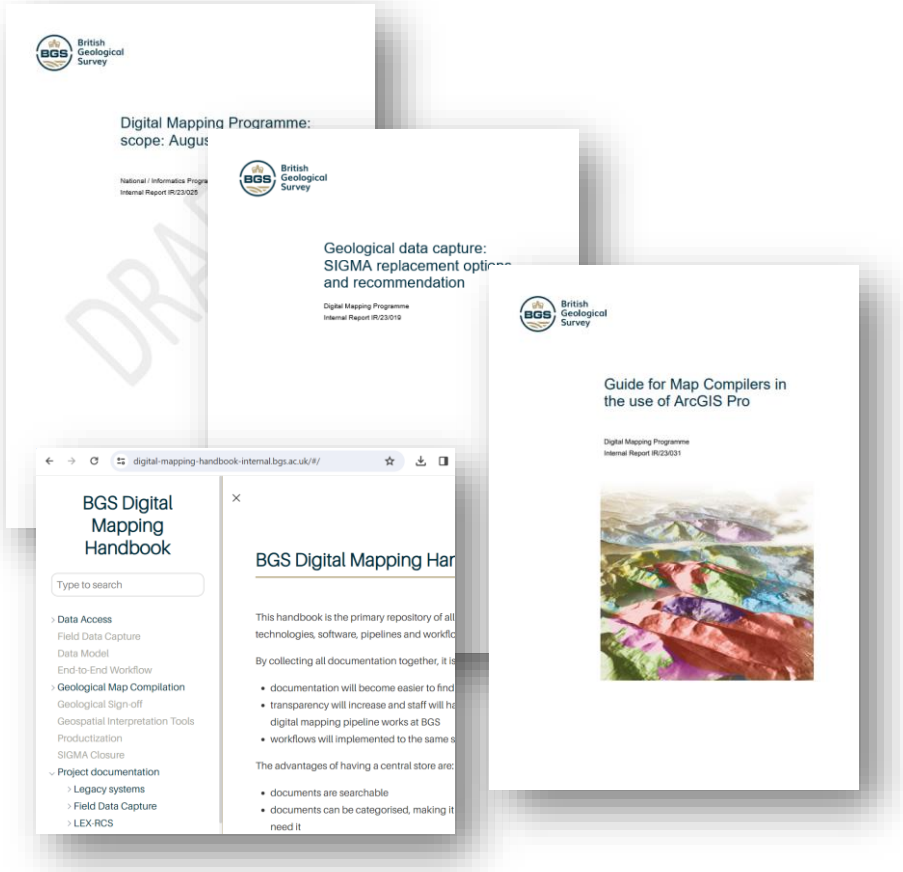
Metadata

Data governance

Data science

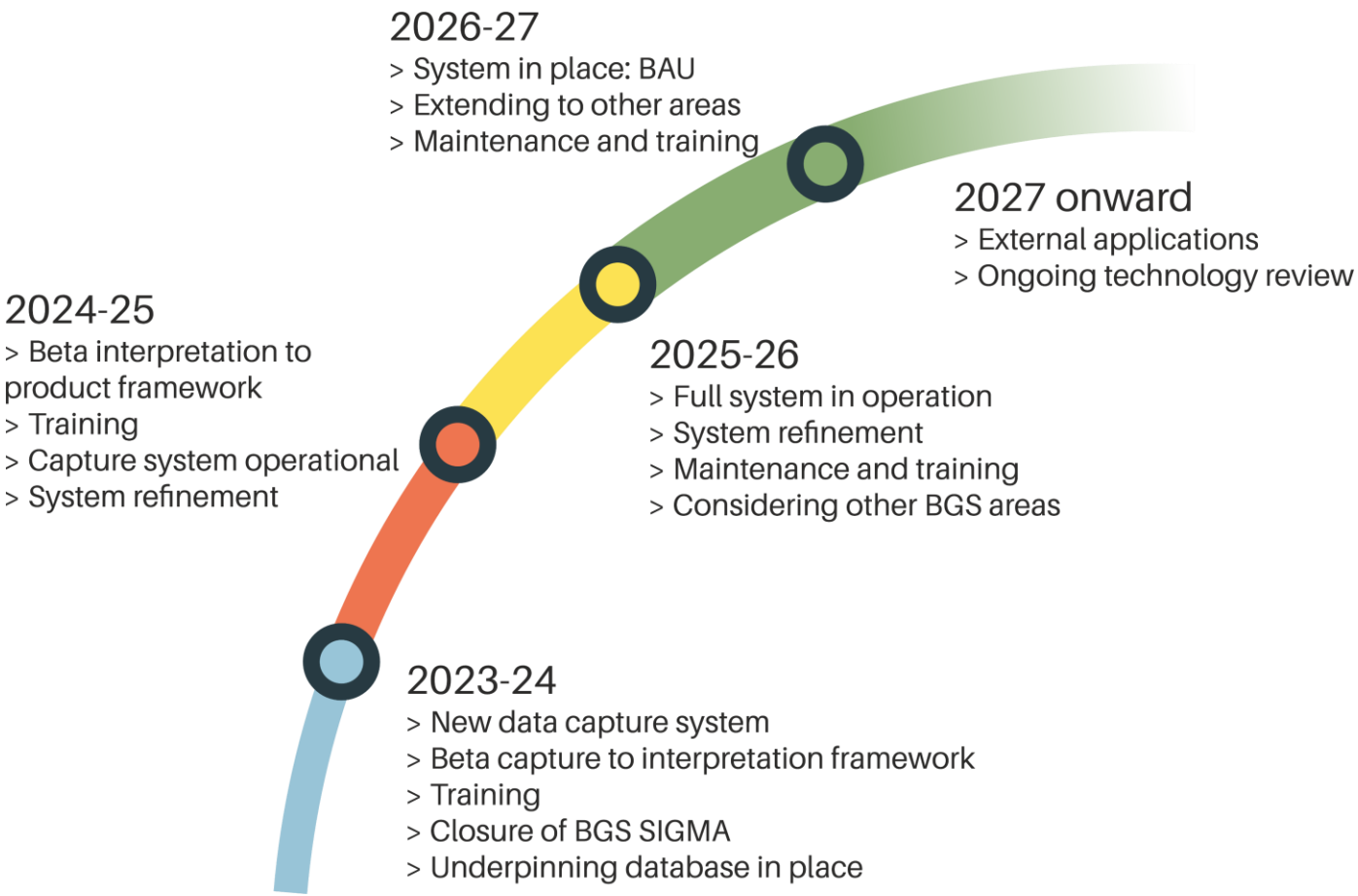
External stakeholders

Managing the change



- Frequent updates and review
- Focus group engagement
- Co-design workshops
- User requirements events
- Accessible documentation
- Training (in person/remote)
- User acceptance testing

Timelines and prioritization


2026-27
> System in place: BAU
> Extending to other areas
> Maintenance and training
2027 onward
> External applications
> Ongoing technology review
2024-25
> Beta interpretation to product framework
> Training
> Capture system operational
> System refinement
2025-26
> Full system in operation
> System refinement
> Maintenance and training
> Considering other BGS areas
2023-24
> New data capture system
> Beta capture to interpretation framework
> Training
> Closure of BGS SIGMA
> Underpinning database in place

Priorities

Field data capture system replacement

Systems to support mapping project continuity

Reviewing and updating BGS mapping standards and expectations

Background development for advanced audting

Digital solutions for field mapping: *beyond BGS-SIGMA*

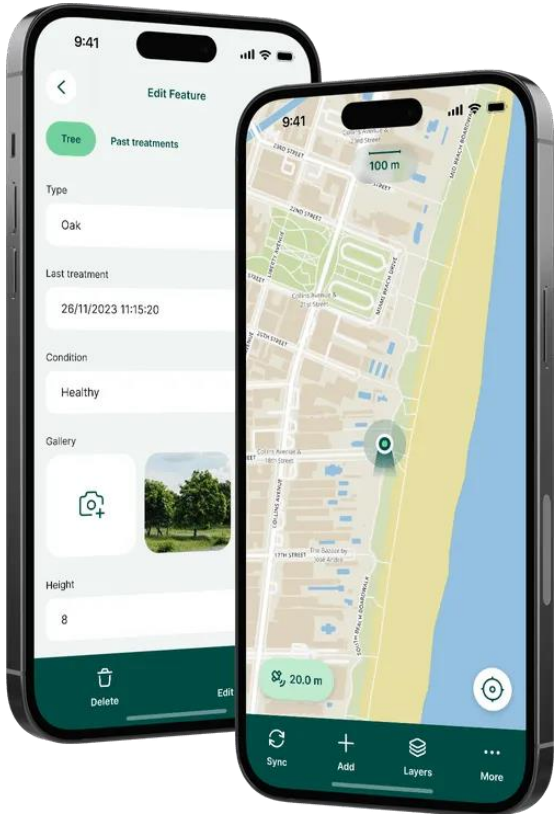
Overhauling our field mapping platform

- BGS·SIGMA in place since the early 2010s
- Integrated GIS and field capture system
- Domestical and international applications
- Internally developed and supported
- February 2024: underpinning software no longer maintained

https://www.bgs.ac.uk/technologies/software/sigma/

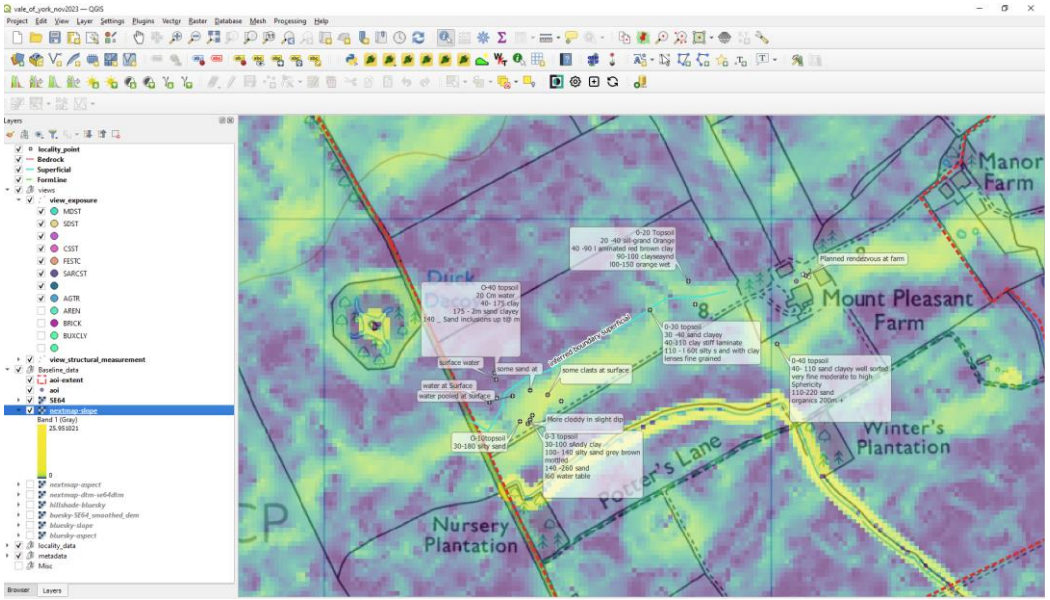
Moving to Mergin Maps

- Modular system
- Open-source technology built on QGIS
- Multiple user syncing
- Fully customisable
- Low license costs



Source: https://merginmaps.com/

Field testing and cross-collaboration



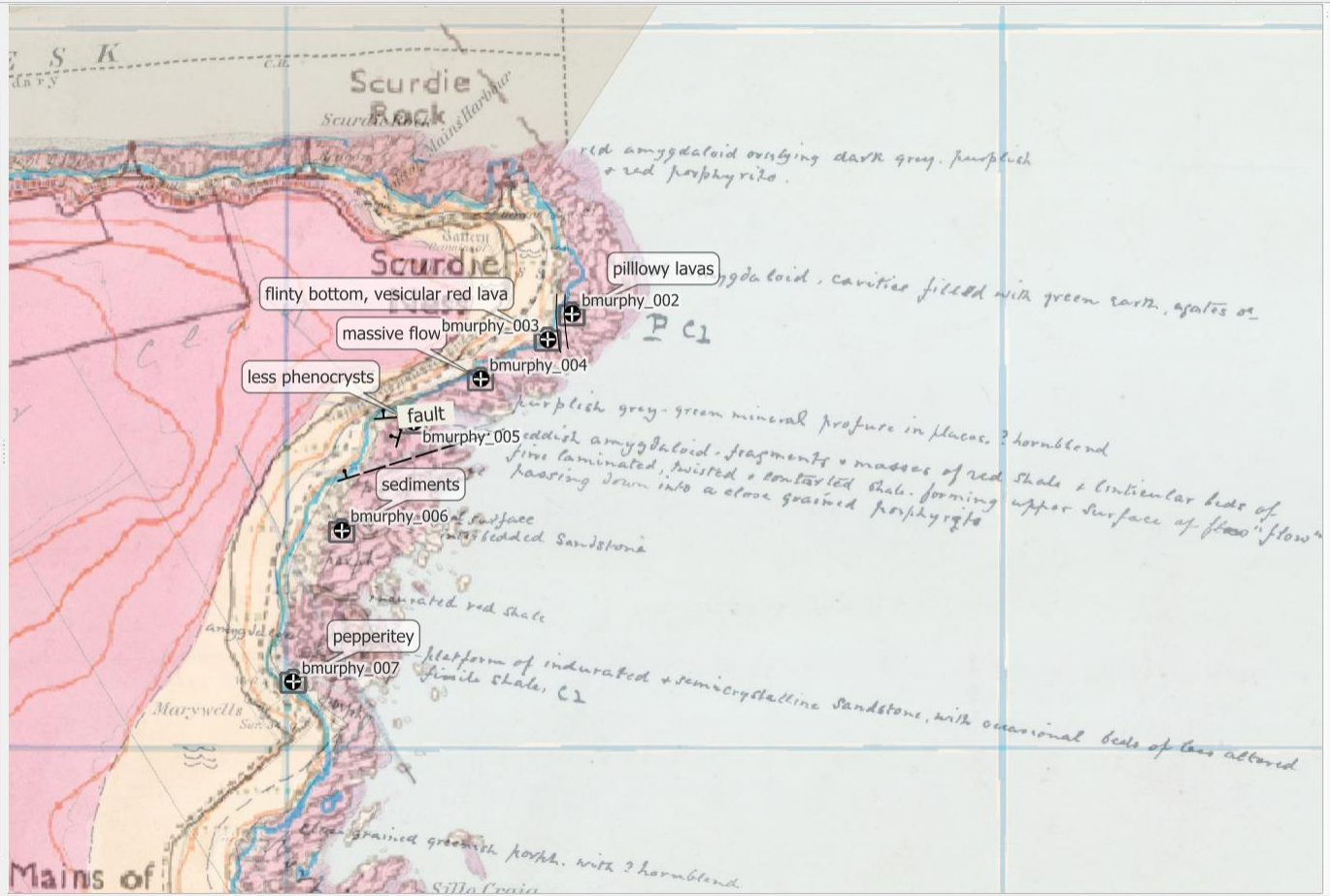
*Strathmore_2024_09 — QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help

Layers

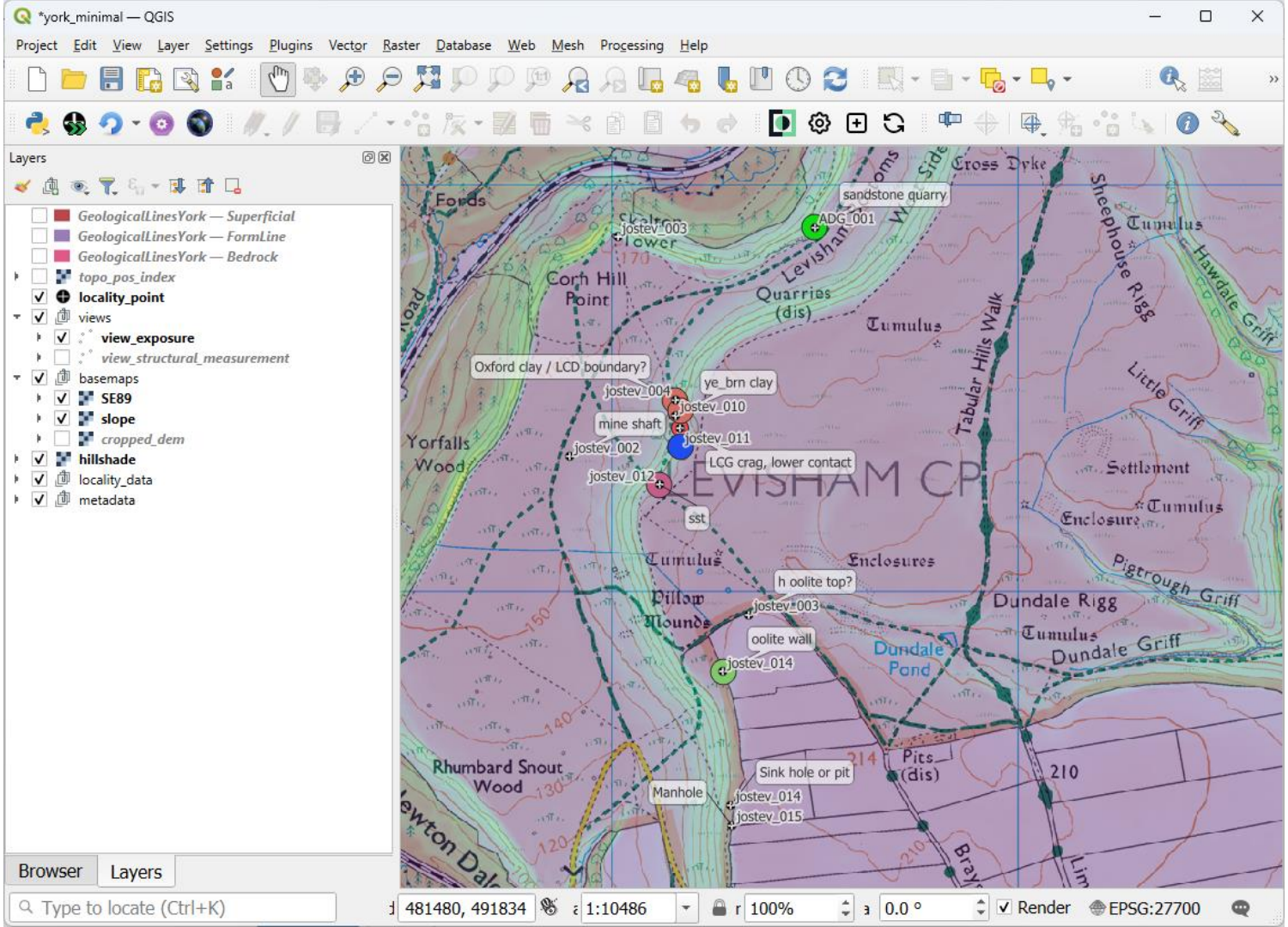
- locality_point
- lines
  - artificial_line
  - bedrock_line
  - mass_move_line
  - superficial_line
  - terrain_line
- views
  - view_structural_measurement
  - view_superficial_landform
  - view_manmade_landform
  - view_photo
  - view_media
  - view_sample
  - view_lithology
- field_project
- locality_data
- metadata
- Fieldslips
- FOP_STRUCTURE
- NewLinework
- BritpitsFiltered
- AllRocks_Aug2024
- LineamentAnalysis
- Volcanics
- Geology50K
- LandAccess_StrathmoreNorth_Restricted
- OS_Leisure_27700_attempt2
- BingSat3

Layers Browser



Type to locate (Ctrl+K)

Coordinate 374253, 756314 Scale 1:7672 Magnifier 100% Rotation 0.0 ° Render EPSG:27700


*york_minimal — QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help
Layers
GeologicalLinesYork — Superficial
GeologicalLinesYork — FormLine
GeologicalLinesYork — Bedrock
topo_pos_index
locality_point
views
view_exposure
view_structural_measurement
basemaps
SE89
slope
cropped_dem
hillshade
locality_data
metadata
Browser
Layers
Type to locate (Ctrl+K)
481480, 491834
1:10486
100%
0.0 °
Render
EPSG:27700
sandstone quarry
ADG_001
jostev_003
Corn Hill Point
Quarries (dis)
Tumulus
Oxford clay / LCD boundary?
jostev_004
ye_brn clay
jostev_010
mine shaft
jostev_011
jostev_002
LCG crag, lower contact
jostev_012
sst
Yorfalls Wood
Tabular Hills Walk
Sheephouse Rigg
Hawdale Griff
Little Griff
Settlement
Enclosure
Enclosures
Pigtrough Griff
Dundale Rigg
Dundale Griff
h oolite top?
jostev_003
Pillow Mounds
oolite wall
jostev_014
Dundale Pond
Rhumbard Snout Wood
Sink hole or pit
Manhole
jostev_014
jostev_015
Pits (dis)
214
210
150
140
130
120
Cross Dyke

field_data_etl/oracle | Prometheus Time Se | Field_Report

file:///C:/Users/jostev/mergin/Strathmore_2024_09/ 90% Search

Locality point: bmurphy_001

Locality type	outcrop
Location	(370463, 747953) - Open Google Map
Locality description	at cliff face roughly 20m north of route down to beach
Map face note	None
Geology description	dark loose purpley scoria material with rubbly texture. some pillowy features at the base. vesicular and containing cm size white crystals and some very small mm scale greenish crystals. broken up by grey/green/blue 'sedimentary' looking layers, these have a rusty redvlooking contact with the surrounding material. Large scale fault trending e-w too difficult to climb up to for accurate measurements
Entered	at 2024-09-09T14:11:11
Updated	at 2024-09-09T14:22:11

Structural measurements

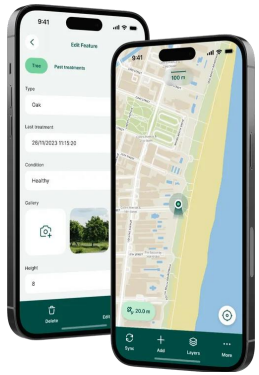
Measurement type	Fault Dip
Dip / Azimuth	88 / 178
Notes	smaller fault plane similar orientation to larger fault - undulating plane White mineral which scratches (calcite) infilling vein
Entered	bmurphy at 2024-09-09T14:26:09
Updated	bmurphy at 2024-09-09T14:29:50

Photos

File name	09-09-2024\DSCF3256.JPG
Caption	Sediment and lava interaction
Entered	bmurphy at 2024-09-27T13:42:55

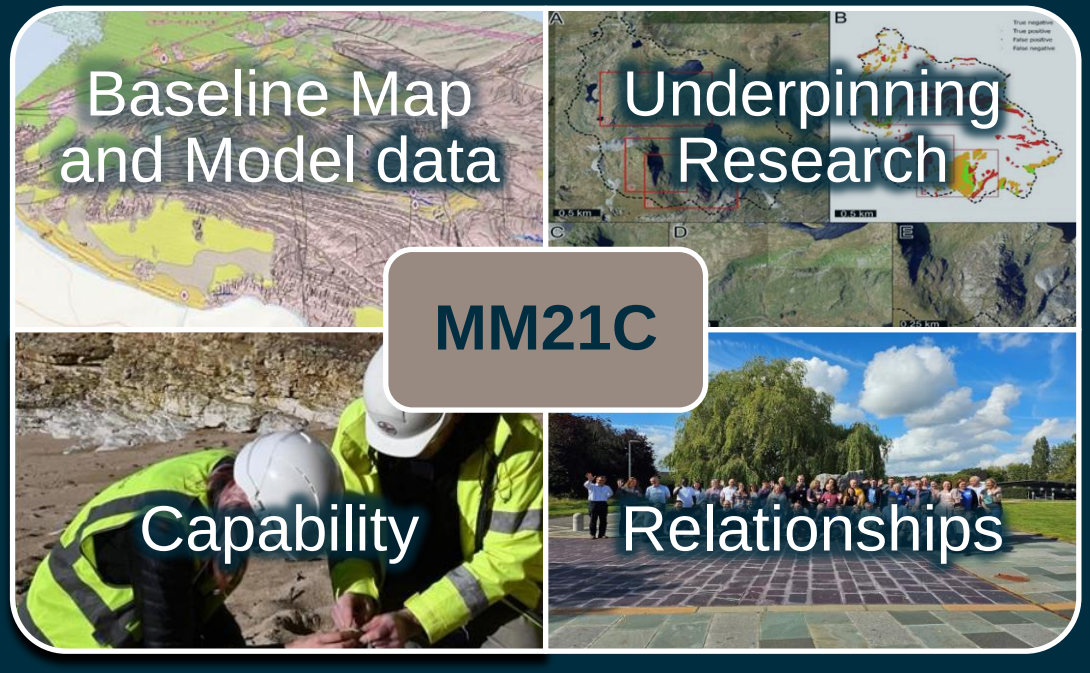
File name	09-09-2024\DSCF3257.JPG
Caption	White mineral filled vein
Entered	bmurphy at 2024-09-27T13:42:55

Source: https://eu.connect.panasonic.com



Source: https://merginmaps.com/

Wider BGS mapping programme alignment



Maps and models for the 21st Century

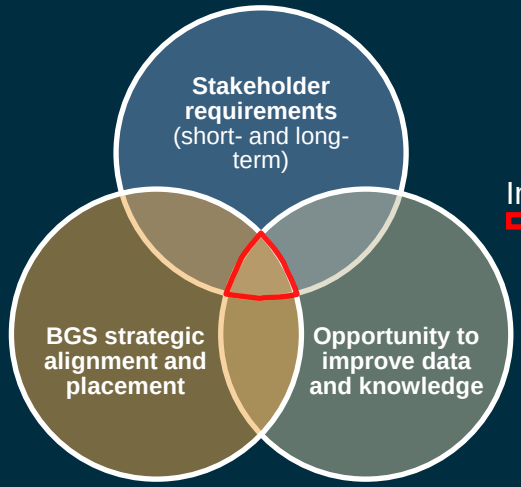
What will we deliver?

A new programme of systematic 2D and 3D geological survey for the UK, targeting strategic priorities onshore and across our continental shelf

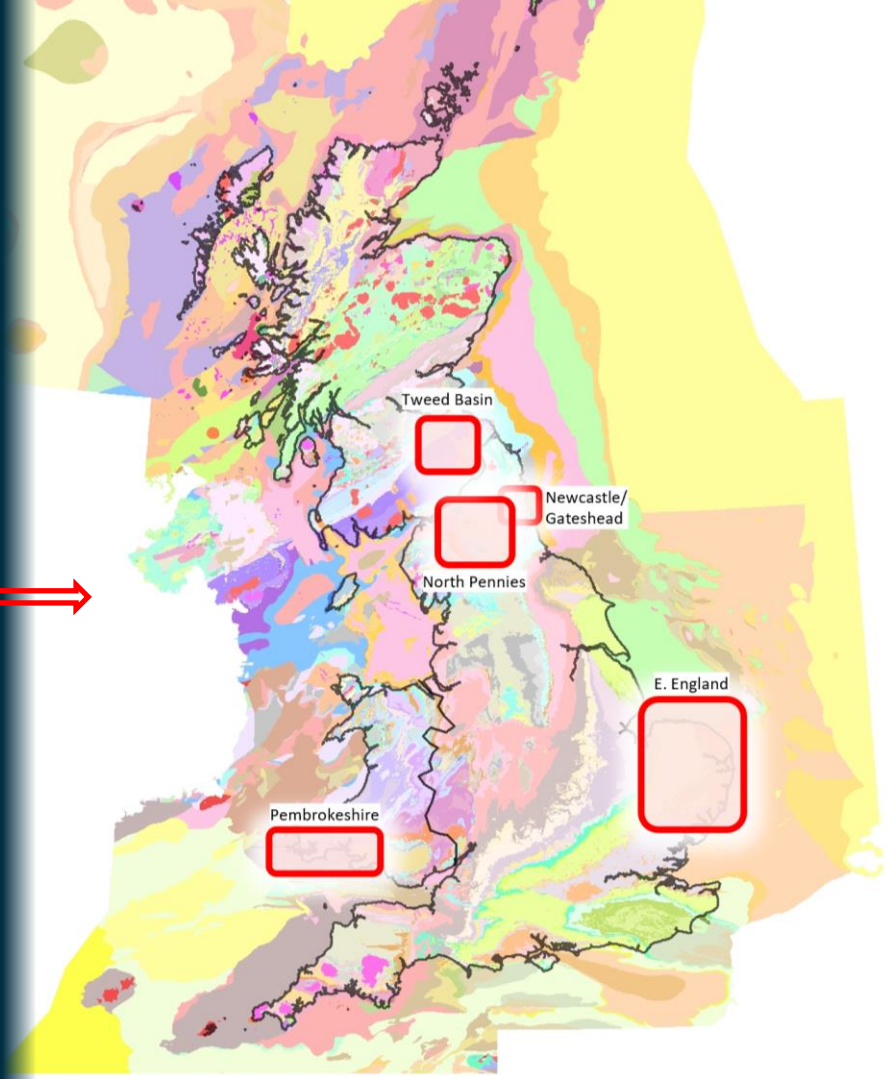
MM21C: technical programme development

- Outcome from engagement and consultation:

  “everywhere, everything, and straightaway”



Initial priorities



- Detailed scoping and external stakeholder engagement ongoing

MM21C: people, skills and culture

- Building capacity and skills:
  - recruitment drive
  - *inclusive* technical training
  - management and leadership pathways

- "Ways or working" for the 21st Century:
  - embed 'Good Practice' thinking
  - emphasis on removing barriers
  - connected approach – integrated science
  - ***sharing of knowledge and experience***

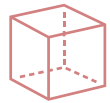

New approaches to old problems

Surface expression mapping: predicting exposed bedrock

“Interpolation” away from traditional geostatistics

Text interpretation from scans

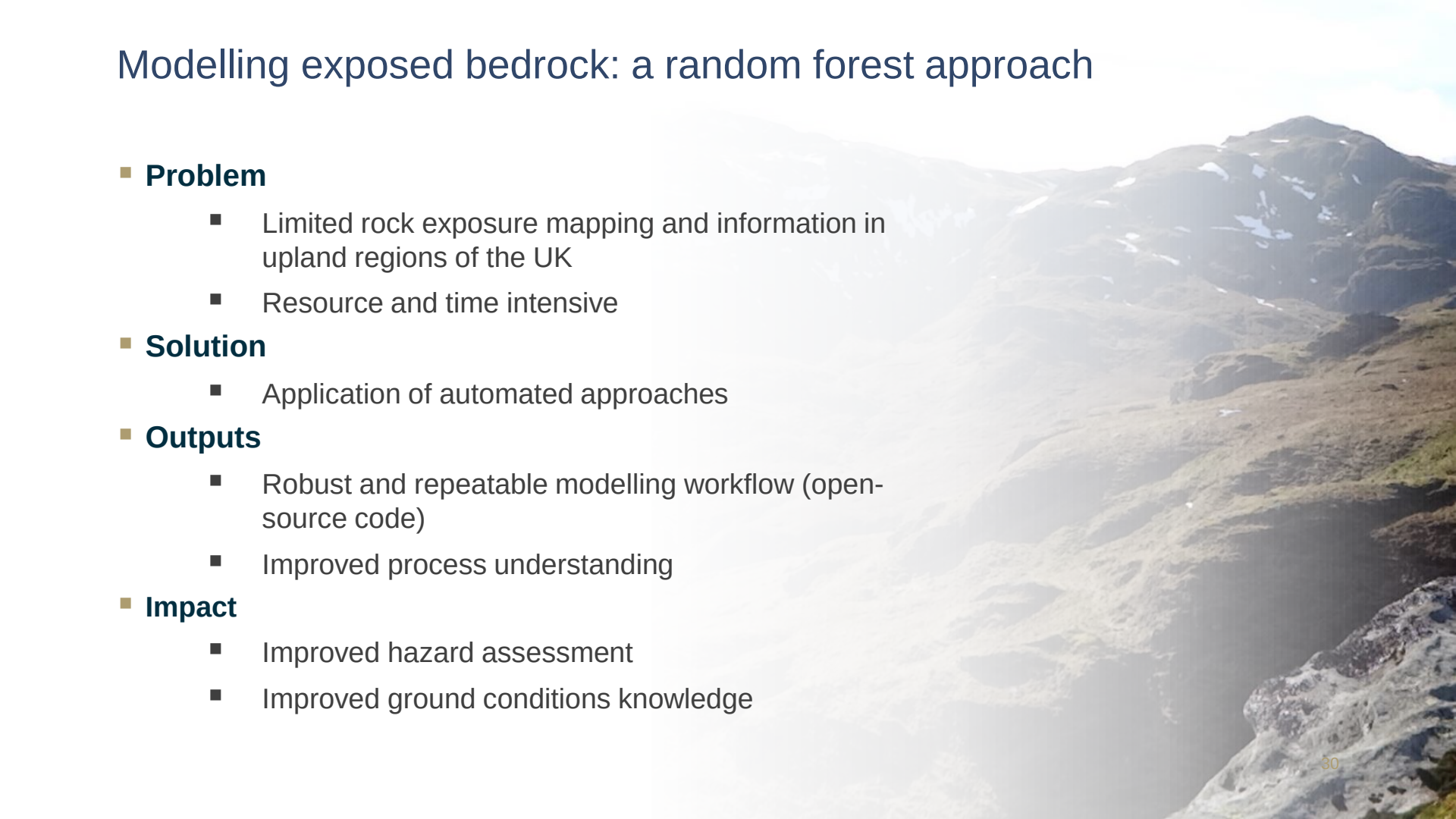
Automated QA for targeted improvements



3D modelling

Modelling exposed bedrock: a random forest approach

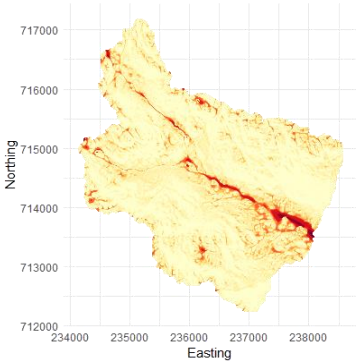
- **Problem**
  - Limited rock exposure mapping and information in upland regions of the UK
  - Resource and time intensive
- **Solution**
  - Application of automated approaches
- **Outputs**
  - Robust and repeatable modelling workflow (open-source code)
  - Improved process understanding
- **Impact**
  - Improved hazard assessment
  - Improved ground conditions knowledge

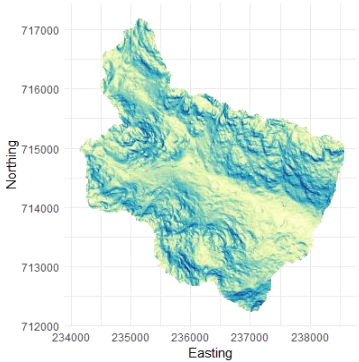


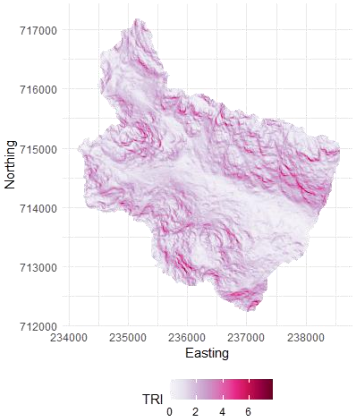
Training data: terrain derivatives

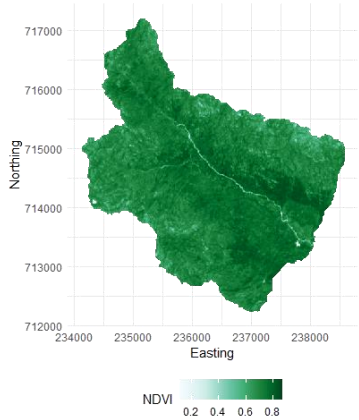
Rock present (1)

Rock absent (0)

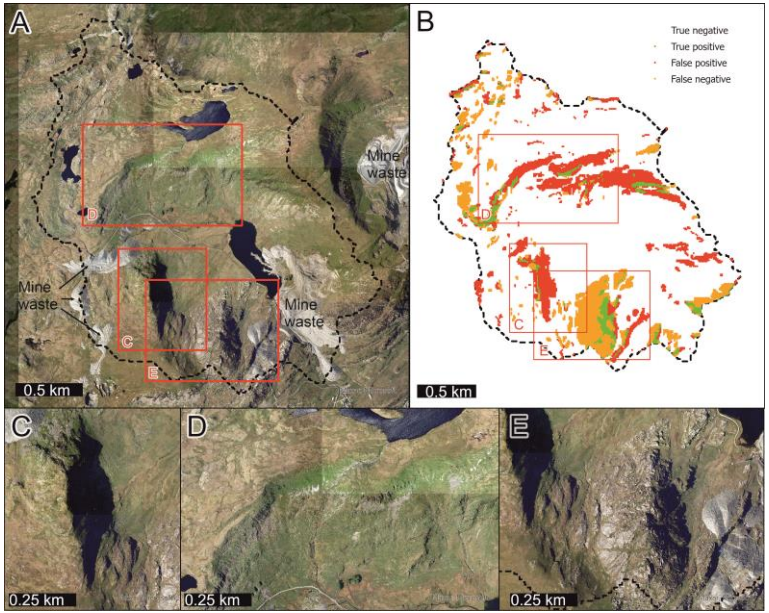




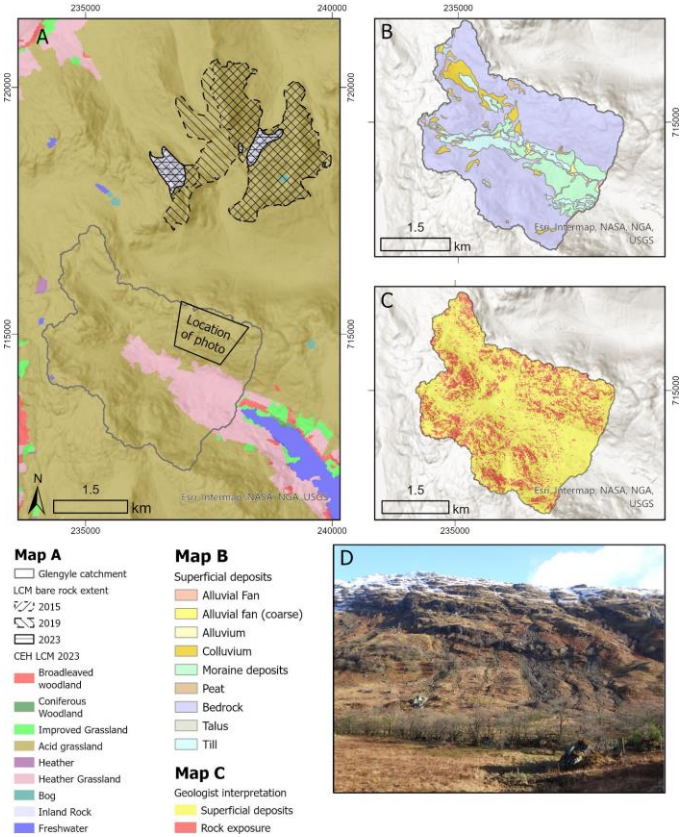




Random Forest code base: geospatial-random-forest



Blaenau catchment model results

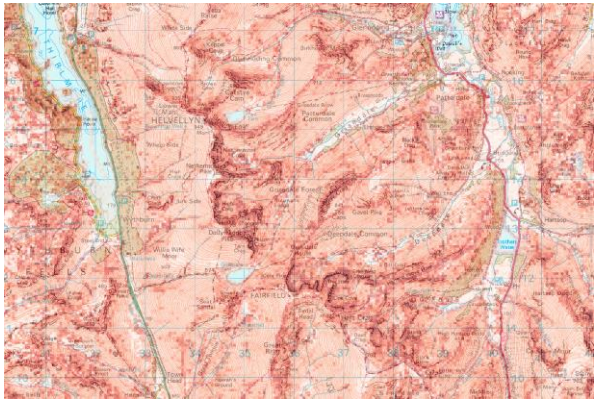


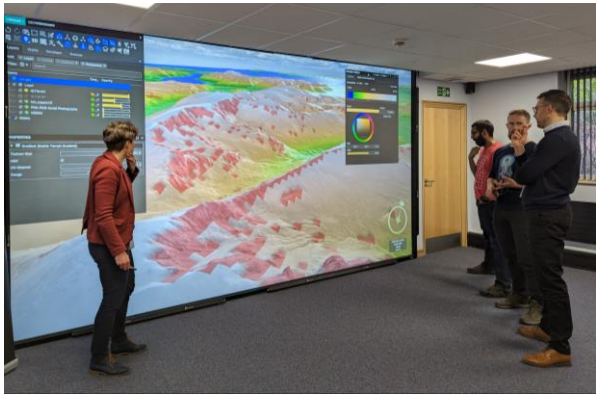
Glen Gyle landcover and geological datasets*

*contains data owned by UK Centre for Ecology & Hydrology © Database Right/Copyright UKCEH

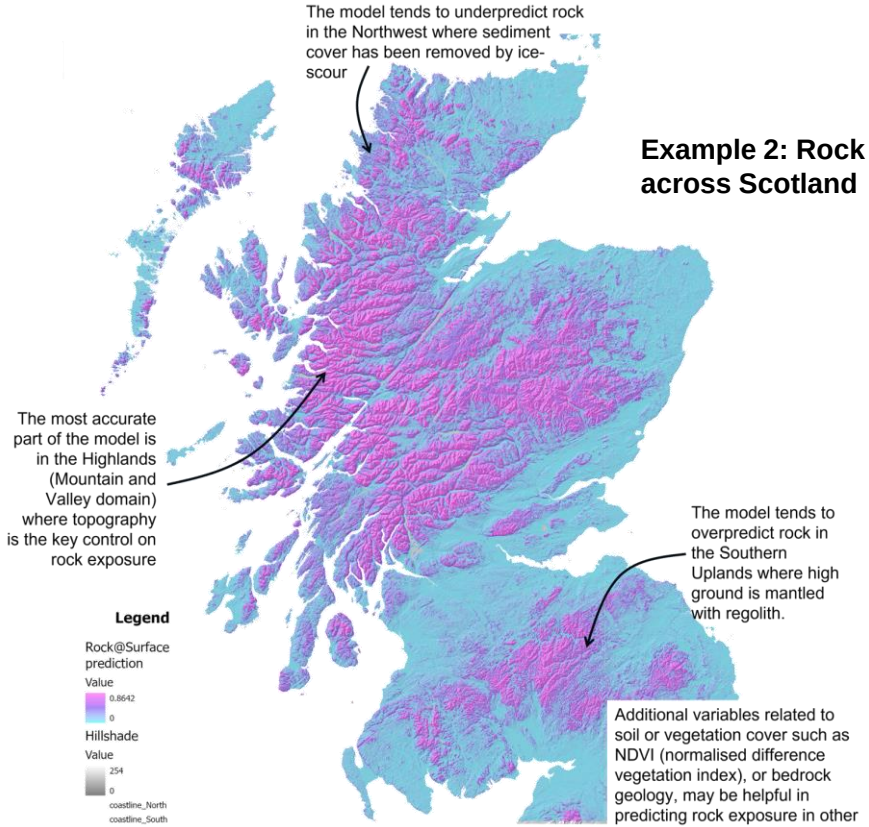
GB based onshore test applications

Example 1: Rock exposure across the Lake District, England





Example 2: Rock exposure across Scotland



Other applications: Fe-Mn distributions in oceanic crust

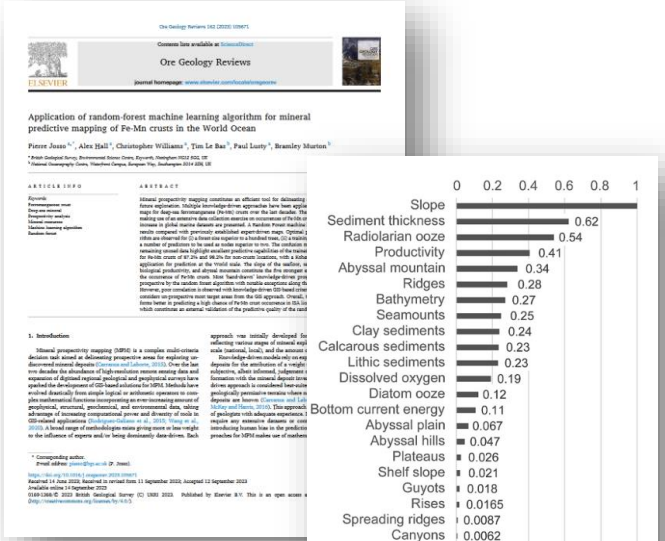


Fig. 3. Rescaled predictor importance in the trained random forest model.

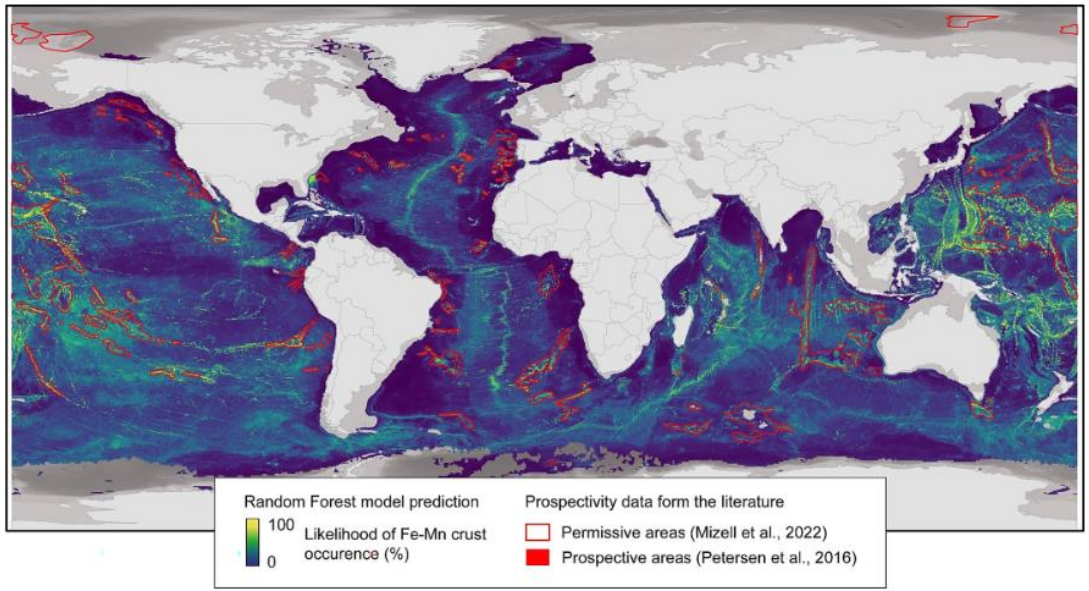


Fig. 4. Probability of Fe-Mn crust occurrence (data available at https://doi.org/10.5285/4c8419b9-5ee4-4db4-b279-18d3ec75c3c4). Previously published mineral prospective maps for Fe-Mn crusts from Mizell et al. (2022) and Petersen et al. (2016) (raw data provided by the authors) are shown in map A. Note that data from Petersen et al. (2016) is displayed with some transparency and may therefore appears in different shades depending on background. Bathymetric data from GEBCO Compilation Group (2021).

https://www.sciencedirect.com/science/article/pii/S0169136823003876

British Geological Survey

CONTACT

Dr Chris Williams

chrwil@bgs.ac.uk